PATENT ABSTRACTS OF JAPAN

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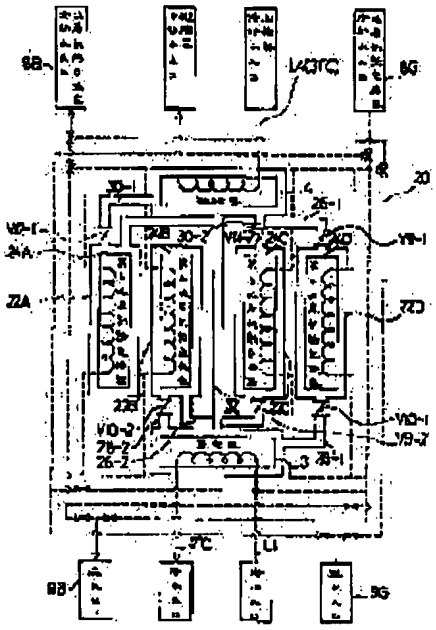
(54) ADSORPTION FREEZER

(57)Abstract:
PURPOSE: To utilize a waste heat of low quality in a system having a plurality of segments including adsorbent heat exchangers by a method wherein each of the plurality of segments is constructed by containing independent regions having the adsorbent heat exchangers and the plurality of regions are communicated to each other by a gaseous heat medium pipe.
CONSTITUTION: In an adsorption freezer 20 having segments affixed with letters A and D and segments affixed with letters B and C, there are provided independent regions 22A to 22D having first to fourth adsorbent heat exchangers 24A to 24D. The regions 22A, 22D; 22B, 22C in the first and second segments are communicated with each other by each of thermal medium pipes 26-1 and 26-2, respectively. In addition, the first segment is communicated with an evaporator 3 through a pipe 28-1 having an opening or closing valve V10-1 therein, and the second segment is communicated with a condenser 4 through pipes 30-1 and 30-2 having each of opening or closing valves V12-1 and V12-2, respectively. Then, when the thermal medium is moved through the pipes 26-1 and 26-2, saturated steam pressure is adjusted and the thermal medium is adsorbed through heating under utilization of waste heat of low quality (water of low temperature).



CLAIMS

[Claim(s)]
[Claim 1]An adsorption freezer, wherein it is constituted including an independent field characterized by comprising the following two or more and a field of this plurality is open for free passage for piping for gaseous phase heat carriers.
An evaporator.
The pipe line which supplies a liquid phase heat carrier to an evaporator.
The pipe line of chilled water cooled by heat exchange of an evaporator.
In an adsorption freezer including the pipe line which supplies cooling water to a condenser and a condenser, and the pipe line which supplies warm water or cooling water to two or more systems and adsorbent heat exchangers which infixed an adsorbent heat exchanger, each of two or more of said systems is an adsorbent heat exchanger.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industry-like field of the invention] The pipe line by which this invention supplies a liquid phase heat carrier to an evaporator and an evaporator, and the pipe line of the chilled water cooled by the heat exchange of an evaporator, It is related with an adsorption freezer including the pipe line which supplies cooling water to a condenser and a condenser, and the pipe line which supplies warm water or cooling water to two or more systems and adsorbent heat exchangers which infixed the heat exchanger of adsorbent.
[0002]
[Description of the Prior Art]The conventional example of such an adsorption freezer is shown by drawing 4. This adsorption freezer uses water as a heat carrier, and uses silica gel or zeolite as adsorbent. The evaporator 3 and the condenser 4 are included by the body part 2 of the adsorption freezer which shows the whole with the numerals 1. The inside of the body part 2 is divided into two fields shown with the numerals A and B, and the adsorbent heat exchangers 5A and 5B are formed in the field, respectively.
[0003]The heat carrier (water) sprayed by the evaporator 3 evaporates, takes evaporation heat, and cools the chilled water which circulates through the pipe line L1. And in the state of drawing 4, the heat carrier (steam) which is shown by numerals HG1 and which evaporated flows into the field A via the partition lid 6A of an opened condition, and is adsorbed by the adsorbent (silica gel or zeolite) with which the adsorbent heat exchanger 5A was filled up. Since it will generate heat if adsorbent adsorbs moisture here, it is cooled with the cooling water supplied via the pipe line L2. What is necessary is just to switch the diverter valve V1 infixed in the pipe line which results in the recovery-of-cooling-water means 8B from the cooling water supply source 8G, and V2 to the system shown as a solid line in drawing 4, in order to supply cooling water to the pipe line L2. Since the partition lid 7A of the field A upper part is eyelid completely closure, a steam is fully adsorbed by the adsorbent in the heat exchanger 5A, without leaking out up.
[0004]On the other hand, in the field B of drawing 4, adsorption by the adsorbent heat exchanger 5B is completed, therefore a steam flows by making the downward partition lid 6B into eyelid completely closure. In this state, the adsorbent of the heat exchanger 5B is adsorbing the steam to near the saturation, and if warm water is supplied via the pipe line L3, as the adsorbed moisture dissociated from adsorbent (desorption) and shown in numerals HG2, it will flow out of the upper partition lid 7B in an opened condition into the condenser 4 side. And the heat of condensation is taken by heat exchange with the cooling water supplied to the condenser 4 via the pipe line L4, and moisture (steam) HG2 desorbed from adsorbent changes, without the liquid phase, i.e., water. This water is sprayed by the evaporator 3 via the pipe line which is not illustrated. In order to supply warm water to the adsorbent heat exchanger 5B, What is necessary is just to switch switching valve V to the system shown as a solid line in a figure, while closing the opening and closing valve V3 shown black among the figure among the opening and closing valves infixed in the pipe line between the source 9G of warm water, and the warm water recovery means 9B, the opening and closing valve V5 which opened V4 wide and was shown in white, and V6.
[0005]If the adsorption in the field A and the desorption in the field B are completed, the partition lids 6A and 7B of an opened condition will be closed, and the partition lids 6B and 7A of eyelid completely closure will be opened. And cooling water is made to supply to the adsorbent heat exchanger 5B side by switching the diverter valve V1 and V to the system side shown by a dotted line by drawing 4. The opening and closing valve V3 and V4 are closed, and while opening the opening and closing valve V5 and V6, the warm water for desorption is made to supply to the adsorbent heat exchanger 5A side by switching the switching valve V2 to the system side shown by the dotted line in a figure.
[0006]When using for general air conditioning the adsorption freezer 1 shown by drawing 4, the inlet temperature (temperature at the time of flowing into the adsorption freezer 1) of the cooling water from the source of cooling water to an adsorbent heat exchanger, and the source 10 of cooling water of the condenser 4 the rated temperature of 31 **, As for the outlet temperature (temperature at the time of flowing out of the adsorption freezer 1) of the chilled water cooled in the evaporator 3, rated temperature of 7 ** is desired. And conventionally, about 65 ** was needed for the inlet temperature of the warm water from the source 9G of warm water. When putting in another way, in order to operate by the rated condition desired as an object for general air conditioning, with the adsorption freezer 1 shown by drawing 4, about 65 ** was needed as a temperature of a drive heat source.
[0007]
[Problem(s) to be Solved by the Invention]Exhaust heat with a comparatively low temperature of 60 ** or less was commonly called "low quality exhaust heat", and it was only discarding (exhaust heat) conventionally. The request of liking to use effectively here in the recent years used as the technical problem that energy saving is big even if it is such low quality exhaust heat is dramatically strong.
[0008]However, as mentioned above, in order to operate in the conventional adsorption freezer by a rated condition (the temperature of the chilled water in which 31 ** of circulating water temperature was obtained is 7 **), about 65 ** is demanded as a temperature of a drive heat source, and low quality exhaust heat of 60 ** or less cannot be used as a drive heat source.
[0009]This invention was proposed in view of the problem of the conventional technology mentioned above, and 31 **, circulating water temperature aims at offer of an adsorption freezer which can use low quality exhaust heat of 60 ** or less as a drive heat source, even if the temperature of the obtained chilled water is 7 ** (operation by a rated condition).

[0010]
[Means for Solving the Problem]The pipe line which supplies a liquid phase heat carrier to an evaporator and an evaporator according to the adsorption freezer of this invention, The pipe line of chilled water cooled by heat exchange of an evaporator, a condenser, and the pipe line that supplies cooling water to a condenser, In an adsorption freezer which includes the pipe line which supplies warm water or cooling water in two or more systems and adsorbent heat exchangers which infixed an adsorbent heat exchanger, each of two or more of said systems is constituted including an independent field provided with an adsorbent heat exchanger two or more, and a field of this plurality is opening it for free passage for piping for gaseous phase heat carriers.
[0011]Although it is preferred to provide two lines, for example as for a system which infixed an adsorbent heat exchanger when carrying out this invention, three or more lines may be provided. And it is preferred to be constituted including two or more independent fields which provided an adsorbent heat exchanger in each system.
[0012]
[Function]Since according to the adsorption freezer of this invention possessing composition which was mentioned above each system is constituted including the field of the plurality which provided the adsorbent heat exchanger aerophore, for example, 2**, and the field is opened for free passage for piping for gaseous phase heat carriers, The concentration of a heat carrier (water or steam) is changed, and it becomes possible to adjust and control maximum vapor tension. The gaseous phase heat carrier (steam) which came out of the evaporator flows into the 1st field in which the adsorbent heat exchanger into which cooling water flows was provided, and is adsorbed. If the adsorption in the 1st field is completed, the opening and closing valve infixed in piping for gaseous phase heat carriers which is open for free passage to the 2nd field will open. Here, if warm water is poured to the heat exchanger of the 1st field and cooling water is poured to the heat exchanger of the 2nd field, the heat carrier adsorbed all over the 1st field by the temperature gradient or the pressure differential will be desorbed, it will flow into the 2nd field, and the adsorbent of the heat exchanger there will adsorb. And if warm water is supplied to the adsorbent heat exchanger of the 2nd field, a heat carrier will be desorbed and it will flow into the condenser side as a gaseous phase heat carrier. And the cooling water and heat exchange of a condenser are performed, and it becomes a liquid phase heat carrier, it is again sprayed by the evaporator through condensate piping, and evaporates.
[0013]When repeating adsorption and desorption in a single field like before, regulation of maximum vapor tension is impossible. Therefore, when the temperature of the chilled water in which 31 ** of circulating water temperature is obtained was 7 ** (operation by a rated condition), the temperature of about 65 ** was required for warm water. On the other hand, in this invention, when moving between the fields where heat carriers differ via piping for gaseous phase heat carriers, even if maximum vapor tension is adjusted and warm water 60 ** or less (for example, 56 **) is supplied to an adsorbent heat exchanger, a heat carrier (water) evaporates and is desorbed. namely, — moving a heat carrier one by one between different fields via piping for gaseous phase heat carriers — etc. — it is made to slide in the direction to which an adsorbent temperature required for a heat carrier to desorb falls by adjusting the operation adsorption concentration range of an adsorbent heat exchanger on an amount-of-adsorption temperature diagram In this case, in the cycle diagram of an adsorption freezer, the maximum vapor tension of three or more levels exists.
[0014]
[Example]Hereafter, one example of this invention is described with reference to drawing 1-3. The same numerals are given to the same member as drawing 4 showing.
[0015]Water is being used for the adsorption freezer of this invention shown with the numerals 20 in drawing 1 as a heat carrier. That is, as a liquid phase heat carrier, the steam is used as water (water of condensation) and a gaseous phase heat carrier.
[0016]The adsorption freezer 20 is constituted including two lines, the system which attaches and shows subscript A and D, and the system which attaches and shows subscript B and C. And the independent field or the portions 22A, 22B, 22C, and 22D, and the 1st adsorbent heat exchanger 24A, the 2nd adsorbent heat exchanger 24B, the 3rd adsorbent heat exchanger 24C and the 4th adsorbent heat exchanger 24D which were provided in the inside are included.
[0017]The portions 22A and 22D are open for free passage by the piping 26-1 for heat carriers.
On the other hand, the portions 22B and 22C are open for free passage by the piping 26-2 for heat carriers.
And the system containing the portions 22A and 22D is open for free passage with the evaporator 3 via the piping 28-1 which infixed opening and closing valve V10-1, and the system containing the portions 22B and 22C is open for free passage with the evaporator 3 via the piping 28-2 which infixed opening and closing valve V10-2. The system containing the system containing the portions 22A and 22D and the portions 22B and 22C is open for free passage to the condenser 4 via the piping 30-1 which infixed opening and closing valve V12-1, and the piping 30-2 which remodeled opening and closing valve V12-2, respectively. The condenser 4 and the evaporator 3 are open for free passage via the piping 32 (piping for liquid phase heat carriers).
[0018]The 1st adsorbent heat exchanger 24A, the 2nd adsorbent heat exchanger 24B, the 3rd adsorbent heat exchanger 24C, and the 4th adsorbent heat exchanger 24D, Although it is open for free passage according to the pipe line as shown by a dotted line in drawing 1 in which the opening and closing valve and the cross valve were infixed, the details are later mentioned for the adsorbent heat exchanger inflow of cooling water 8G, the adsorbent heat exchanger outflow of cooling water 8B, the hot water inlet 9G, and the hot water outlet 9B with reference to drawing 2 and 3.
[0019]In drawing 2, as the arrow G-1 shows, the steam by which it was generated with the evaporator 3 flows into the portion 22D via the piping 28-1 which valve V10-1 has opened wide, and is adsorbed by the 4th adsorbent heat exchanger 24D. The cross valve V20 of the adsorbent heat exchanger entrance 8G arranged immediately downstream makes the cooling water from this entrance 8G flow into the piping L11 in the state of drawing 2. It cools that the piping L11 branches to the piping L12 and L13, and the cooling water which flows through the piping L12 generates heat when the 4th adsorbent heat exchanger 24D adsorbs moisture. After cooling the heat exchanger 24D, the cooling water which flows through the inside of the piping L12 joins the piping L14, and flows into the piping L15 via the cross valve V21. And it is sent to the adsorbent heat exchanger outflow of cooling water 8B via the cross valve V22 and the piping L16.
[0020]Here, since opening and closing valve V9-1 infixed in the piping 26-1 for gaseous phase heat carriers is eyelid completely closure, the steam which flowed into the portion 22D stops at the portion 22D concerned, and is efficiently adsorbed by adsorbent.
[0021]After the adsorption in the portion 22D is completed, as drawing 3 shows, opening and closing valve V10-1 is

closed, and valve V9-1 is opened. Simultaneously, the about [hot water inlet 9G] opening and closing valve V23 is opened wide, and warm water is flowed in the piping L17. The cross valve V21 is switched, warm water is poured for the piping L14, and the warm water which flows through the piping L12 which branched from L14 heats the 4th adsorbent heat exchanger 24D. Since adsorbent is heated with warm water, the adsorbed moisture is desorbed. Here, rather than the portion 22D, the portion 22A flows into the portion 22A via the piping 26-1 for gaseous phase heat carriers, as the arrow G2 shows the moisture which desorbed the 4th adsorbent heat exchanger 24D, since it is low temperature and low pressure. The warm water supplied to the heat exchanger 24D is returned to the hot water outlet 9B via the piping L18 and the opening and closing valve V24.
[0022]The moisture which flowed into the portion 22A is adsorbed by the 1st adsorbent heat exchanger 24A. The heat generated when adsorbing is removed from the adsorbent heat exchanger inflow of cooling water 8G by the cooling water supplied via the valve V20, the piping L19, and L20. This cooling water is sent out to the absorbent heat exchanger outflow of cooling water 8B via the piping L22, the valve V25, V22, and the piping L16.
[0023]If the adsorption in the portion 22A is completed, it will be in the state which shows by drawing 2 again. That is, since the opening and closing valve V26 and V27 are opened wide, warm water heats the 1st adsorbent heat exchanger 24A from the hot water outlet 9G via the opening and closing valve V26, the piping L23, and L20. Warm water is returned to the hot water outlet 9B after heating via the piping L22, the valve V25, the piping L24, and the valve V27.
[0024]Since the moisture which the 1st adsorbent heat exchanger 24A was heated, and was adsorbed desorbs and opening and closing valve V12-1 opens, the desorbed moisture (steam) reaches the condenser 4 via the piping 30-1, as arrow G3 shows. And it condenses with the condenser 4 and changes to the liquid phase. And the water of condensation is sprayed by the evaporator 3 via the piping 32, as the arrow HL shows.
[0025]The above is the same also about the system containing the portions 22B and 22C, although the system containing the portions 22A and 22D was explained. If the circulating route of the heat carrier by this system is explained, as drawing 3 shows, the steam which evaporated with the evaporator 3 will flow into the portion 22B first via the piping 28-2 and opening and closing valve V10-2, as the arrow G4 shows. And it adsorbs by the 2nd adsorbent heat exchanger 24B. Generation of heat by adsorption is removed from the adsorbent heat exchanger inflow of cooling water 8G by the cooling water supplied via the piping L19 and L25.
[0026]If adsorption of the portion 22B is completed, as drawing 2 shows, opening and closing valve V9-2 will be opened wide, and a steam will be made to flow into the portion 22C via the piping 26-2 for gaseous phase heat carriers, as the arrow G5 shows. In this case, in order to heat the 2nd adsorbent heat exchanger 24B, warm water is supplied via the piping L23 and L26 from the hot water inlet 9G. On the other hand, in order to cool the 3rd adsorbent heat exchanger 24C, cooling water is supplied via the piping L11 and L13 from the adsorbent heat exchanger inflow of cooling water 8G.

[0027]If adsorption of the portion 22C is completed, it will desorb by heating the 3rd adsorbent heat exchanger 24C with the warm water supplied via the piping L17, L14, and L13 from the hot water inlet 9G, as again shown in drawing 3. As a result, as the arrow G6 of drawing 3 shows, a steam is sent to the condenser 4 via the piping 30-2. And it is sent to the evaporator 3 via the piping 32 in the state of the liquid phase (numerals HL).
[0028]In the example of a graphic display, even if it sets the temperature of the chilled water which can obtain 31 ** of circulating water temperature as 7 ** (it operates by a rated condition), the temperature of warm water operates enough at 56 **. That is, desorption in each heat-of-adsorption exchanger 24A-24D is performed at about 56 **. This provides two portions (22A, 22D, or 22B and 22C) in each system, two heat-of-adsorption exchangers (24A and 24D.) with an operation adsorption concentration range which opens between each portion for free passage by the piping 26-1 for gaseous phase heat carriers, or 26-2, and is different in a heat carrier Or it is because the fall of a temperature required for a heat carrier to desorb by making it move to 24B and 24C in different maximum vapor tension one by one was aimed at.
[0029]It writes in addition that the example of a graphic display is not what is illustration to the last and means limitation of the technical scope of this invention.
[0030]
[Effect of the Invention]The operation effects of this invention are enumerated below.
[0031](1) Low quality exhaust heat (low temperature exhaust heat) of 60 or less ** is used effectively as a heat source of an adsorption freezer.
[0032](2) It can respond to the request of energy saving.

[Translation done.]

TECHNICAL FIELD

[Industry-like field of the invention] The pipe line by which this invention supplies a liquid phase heat carrier to an evaporator and an evaporator, and the pipe line of the chilled water cooled by the heat exchange of an evaporator, It is related with an adsorption freezer including the pipe line which supplies cooling water to a condenser and a condenser, and the pipe line which supplies warm water or cooling water to two or more systems and adsorbent heat exchangers which infixed the heat exchanger of adsorbent.

[Translation done.]

PRIOR ART

[Description of the Prior Art]The conventional example of such an adsorption freezer is shown by drawing 4. This adsorption freezer uses water as a heat carrier, and uses silica gel or zeolite as adsorbent. The evaporator 3 and the condenser 4 are included by the body part 2 of the adsorption freezer which shows the whole with the numerals 1. The inside of the body part 2 is divided into two fields shown with the numerals A and B, and the adsorbent heat exchangers 5A and 5B are formed in the field, respectively.

[0003]The heat carrier (water) sprayed by the evaporator 3 evaporates, takes evaporation heat, and cools the chilled water which circulates through the pipe line L1. And in the state of drawing 4, the heat carrier (steam) which is shown by numerals HG1 and which evaporated flows into the field A via the partition lid 6A of an opened condition, and is adsorbed by the adsorbent (silica gel or zeolite) with which the adsorbent heat exchanger 5A was filled up. Since it will generate heat if adsorbent adsorbs moisture here, it is cooled with the cooling water supplied via the pipe line L2. What is necessary is just to switch the diverter valve V1 infixed in the pipe line which results in the recovery-of-cooling-water means 8B from the cooling water supply source 8G, and V2 to the system shown as a solid line in drawing 4, in order to supply cooling water to the pipe line L2. Since the partition lid 7A of the field A upper part is eyelid completely closure, a steam is fully adsorbed by the adsorbent in the heat exchanger 5A, without leaking out up.

[0004]On the other hand, in the field B of drawing 4, adsorption by the adsorbent heat exchanger 5B is completed, therefore a steam flows by making the downward partition lid 6B into eyelid completely closure. In this state, the adsorbent of the heat exchanger 5B is adsorbing the steam to near the saturation, and if warm water is supplied via the pipe line L3, as the adsorbed moisture dissociated from adsorbent (desorption) and shown in numerals HG2, it will flow out of the upper partition lid 7B in an opened condition into the condenser 4 side. And the heat of condensation is taken by heat exchange with the cooling water supplied to the condenser 4 via the pipe line L4, and moisture (steam) HG2 desorbed from adsorbent changes, without the liquid phase, i.e., water. This water is sprayed by the evaporator 3 via the pipe line which is not illustrated. In order to supply warm water to the adsorbent heat exchanger 5B, What is necessary is just to switch switching valve V to the system shown as a solid line in a figure, while closing the opening and closing valve V3 shown black among the figure among the opening and closing valves infixed in the pipe line between the source 9G of warm water, and the warm water recovery means 9B, the opening and closing valve V5 which opened V4 wide and was shown in white, and V6.

[0005]If the adsorption in the field A and the desorption in the field B are completed, the partition lids 6A and 7B of an opened condition will be closed, and the partition lids 6B and 7A of eyelid completely closure will be opened. And cooling water is made to supply to the adsorbent heat exchanger 5B side by switching the diverter valve V1 and V to the system side shown by a dotted line by drawing 4. The opening and closing valve V3 and V4 are closed, and while opening the opening and closing valve V5 and V6, the warm water for desorption is made to supply to the adsorbent heat exchanger 5A side by switching the switching valve V2 to the system side shown by the dotted line in a figure.

[0006]When using for general air conditioning the adsorption freezer 1 shown by drawing 4, the inlet temperature (temperature at the time of flowing into the adsorption freezer 1) of the cooling water from the source of cooling water to an adsorbent heat exchanger, and the source 10 of cooling water of the condenser 4 the rated temperature of 31 **. As for the outlet temperature (temperature at the time of flowing out of the adsorption freezer 1) of the chilled water cooled in the evaporator 3, rated temperature of 7 ** is desired. And conventionally, about 65 ** was needed for the inlet temperature of the warm water from the source 9G of warm water. When putting in another way, in order to operate by the rated condition desired as an object for general air conditioning, with the adsorption freezer 1 shown by drawing 4, about 65 ** was needed as a temperature of a drive heat source.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]The operation effects of this invention are enumerated below.
[0031](1) Low quality exhaust heat (low temperature exhaust heat) of 60 or less ** is used effectively as a heat source of an adsorption freezer.
[0032](2) It can respond to the request of energy saving.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]Exhaust heat with a comparatively low temperature of 60 ** or less was commonly called "low quality exhaust heat", and it was only discarding (exhaust heat) conventionally. The request of liking to use effectively here in the recent years used as the technical problem that energy saving is big even if it is such low quality exhaust heat is dramatically strong.
[0008]However, as mentioned above, in order to operate in the conventional adsorption freezer by a rated condition (the temperature of the chilled water in which 31 ** of circulating water temperature was obtained is 7 **), about 65 ** is demanded as a temperature of a drive heat source, and low quality exhaust heat of 60 ** or less cannot be used as a drive heat source.
[0009]This invention was proposed in view of the problem of the conventional technology mentioned above, and 31 **, circulating water temperature aims at offer of an adsorption freezer which can use low quality exhaust heat of 60 ** or less as a drive heat source, even if the temperature of the obtained chilled water is 7 ** (operation by a rated condition).

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem]The pipe line which supplies a liquid phase heat carrier to an evaporator and an evaporator according to the adsorption freezer of this invention, The pipe line of chilled water cooled by heat exchange of an evaporator, a condenser, and the pipe line that supplies cooling water to a condenser, In an adsorption freezer which includes the pipe line which supplies warm water or cooling water in two or more systems and adsorbent heat exchangers which infixed an adsorbent heat exchanger, each of two or more of said systems is constituted including an independent field provided with an adsorbent heat exchanger two or more, and a field of this plurality is opening it for free passage for piping for gaseous phase heat carriers.
[0011]Although it is preferred to provide two lines, for example as for a system which infixed an adsorbent heat exchanger when carrying out this invention, three or more lines may be provided. And it is preferred to be constituted including two or more independent fields which provided an adsorbent heat exchanger in each system.

[Translation done.]

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OPERATION

[Function]Since according to the adsorption freezer of this invention possessing composition which was mentioned above each system is constituted including the field of the plurality which provided the adsorbent heat exchanger aerophore, for example, 2**, and the field is opened for free passage for piping for gaseous phase heat carriers, The concentration of a heat carrier (water or steam) is changed, and it becomes possible to adjust and control maximum vapor tension. The gaseous phase heat carrier (steam) which came out of the evaporator flows into the 1st field in which the adsorbent heat exchanger into which cooling water flows was provided, and is adsorbed. If the adsorption in the 1st field is completed, the opening and closing valve infixed in piping for gaseous phase heat carriers which is open for free passage to the 2nd field will open. Here, if warm water is poured to the heat exchanger of the 1st field and cooling water is poured to the heat exchanger of the 2nd field, the heat carrier adsorbed all over the 1st field by the temperature gradient or the pressure differential will be desorbed, it will flow into the 2nd field, and the adsorbent of the heat exchanger there will adsorb. And if warm water is supplied to the adsorbent heat exchanger of the 2nd field, a heat carrier will be desorbed and it will flow into the condenser side as a gaseous phase heat carrier. And the cooling water and heat exchange of a condenser are performed, and it becomes a liquid phase heat carrier, it is again sprayed by the evaporator through condensate piping, and evaporates.
[0013]When repeating adsorption and desorption in a single field like before, regulation of maximum vapor tension is impossible. Therefore, when the temperature of the chilled water in which 31 ** of circulating water temperature is obtained was 7 ** (operation by a rated condition), the temperature of about 65 ** was required for warm water. On the other hand, in this invention, when moving between the fields where heat carriers differ via piping for gaseous phase heat carriers, even if maximum vapor tension is adjusted and warm water 60 ** or less (for example, 56 **) is supplied to an adsorbent heat exchanger, a heat carrier (water) evaporates and is desorbed. namely, — moving a heat carrier one by one between different fields via piping for gaseous phase heat carriers — etc. — it is made to slide in the direction to which an adsorbent temperature required for a heat carrier to desorb falls by adjusting the operation adsorption concentration range of an adsorbent heat exchanger on an amount-of-adsorption temperature diagram In this case, in the cycle diagram of an adsorption freezer, the maximum vapor tension of three or more levels exists.

[Translation done.]

EXAMPLE

[Example]Hereafter, one example of this invention is described with reference to drawing 1-3. The same numerals are given to the same member as drawing 4 showing.
[0015]Water is being used for the adsorption freezer of this invention shown with the numerals 20 in drawing 1 as a heat carrier. That is, as a liquid phase heat carrier, the steam is used as water (water of condensation) and a gaseous phase heat carrier.
[0016]The adsorption freezer 20 is constituted including two lines, the system which attaches and shows subscript A and D, and the system which attaches and shows subscript B and C. And the independent field or the portions 22A, 22B, 22C, and 22D, and the 1st adsorbent heat exchanger 24A, the 2nd adsorbent heat exchanger 24B, the 3rd adsorbent heat exchanger 24C and the 4th adsorbent heat exchanger 24D which were provided in the inside are included.
[0017]The portions 22A and 22D are open for free passage by the piping 26-1 for heat carriers.
On the other hand, the portions 22B and 22C are open for free passage by the piping 26-2 for heat carriers.
And the system containing the portions 22A and 22D is open for free passage with the evaporator 3 via the piping 28-1 which infixed opening and closing valve V10-1, and the system containing the portions 22B and 22C is open for free passage with the evaporator 3 via the piping 28-2 which infixed opening and closing valve V10-2. The system containing the system containing the portions 22A and 22D and the portions 22B and 22C is open for free passage to the condenser 4 via the piping 30-1 which infixed opening and closing valve V12-1, and the piping 30-2 which remodeled opening and closing valve V12-2, respectively. The condenser 4 and the evaporator 3 are open for free passage via the piping 32 (piping for liquid phase heat carriers).
[0018]The 1st adsorbent heat exchanger 24A, the 2nd adsorbent heat exchanger 24B, the 3rd adsorbent heat exchanger 24C, and the 4th adsorbent heat exchanger 24D, Although it is open for free passage according to the pipe line as shown by a dotted line in drawing 1 in which the opening and closing valve and the cross valve were infixed, the details are later mentioned for the adsorbent heat exchanger inflow of cooling water 8G, the adsorbent heat exchanger outflow of cooling water 8B, the hot water inlet 9G, and the hot water outlet 9B with reference to drawing 2 and 3.
[0019]In drawing 2, as the arrow G-1 shows, the steam by which it was generated with the evaporator 3 flows into the portion 22D via the piping 28-1 which valve V10-1 has opened wide, and is adsorbed by the 4th adsorbent heat exchanger 24D. The cross valve V20 of the adsorbent heat exchanger entrance 8G arranged immediately downstream makes the cooling water from this entrance 8G flow into the piping L11 in the state of drawing 2. It cools that the piping L11 branches to the piping L12 and L13, and the cooling water which flows through the piping L12 generates heat when the 4th adsorbent heat exchanger 24D adsorbs moisture. After cooling the heat exchanger 24D, the cooling water which flows through the inside of the piping L12 joins the piping L14, and flows into the piping L15 via the cross valve V21. And it is sent to the adsorbent heat exchanger outflow of cooling water 8B via the cross valve V22 and the piping L16.
[0020]Here, since opening and closing valve V9-1 infixed in the piping 26-1 for gaseous phase heat carriers is eyelid completely closure, the steam which flowed into the portion 22D stops at the portion 22D concerned, and is efficiently adsorbed by adsorbent.
[0021]After the adsorption in the portion 22D is completed, as drawing 3 shows, opening and closing valve V10-1 is closed, and valve V9-1 is opened. Simultaneously, the about [hot water inlet 9G] opening and closing valve V23 is opened wide, and warm water is flowed in the piping L17. The cross valve V21 is switched, warm water is poured for the piping L14, and the warm water which flows through the piping L12 which branched from L14 heats the 4th adsorbent heat exchanger 24D. Since adsorbent is heated with warm water, the adsorbed moisture is desorbed. Here, rather than the portion 22D, the portion 22A flows into the portion 22A via the piping 26-1 for gaseous phase heat carriers, as the arrow G2 shows the moisture which desorbed the 4th adsorbent heat exchanger 24D, since it is low temperature and low pressure. The warm water supplied to the heat exchanger 24D is returned to the hot water outlet 9B via the piping L18 and the opening and closing valve V24.
[0022]The moisture which flowed into the portion 22A is adsorbed by the 1st adsorbent heat exchanger 24A. The heat generated when adsorbing is removed from the adsorbent heat exchanger inflow of cooling water 8G by the cooling water supplied via the valve V20, the piping L19, and L20. This cooling water is sent out to the absorbent heat exchanger outflow of cooling water 8B via the piping L22, the valve V25, V22, and the piping L16.
[0023]If the adsorption in the portion 22A is completed, it will be in the state which shows by drawing 2 again. That is, since the opening and closing valve V26 and V27 are opened wide, warm water heats the 1st adsorbent heat exchanger 24A from the hot water outlet 9G via the opening and closing valve V26, the piping L23, and L20. Warm water is returned to the hot water outlet 9B after heating via the piping L22, the valve V25, the piping L24, and the valve V27.
[0024]Since the moisture which the 1st adsorbent heat exchanger 24A was heated, and was adsorbed desorbs and opening and closing valve V12-1 opens, the desorbed moisture (steam) reaches the condenser 4 via the piping 30-1, as arrow G3 shows. And it condenses with the condenser 4 and changes to the liquid phase. And the water of condensation is sprayed by the evaporator 3 via the piping 32, as the arrow HL shows.
[0025]The above is the same also about the system containing the portions 22B and 22C, although the system containing the portions 22A and 22D was explained. If the circulating route of the heat carrier by this system is explained, as drawing 3 shows, the steam which evaporated with the evaporator 3 will flow into the portion 22B first via the piping 28-2 and opening and closing valve V10-2, as the arrow G4 shows. And it adsorbs by the 2nd adsorbent heat exchanger 24B. Generation of heat by adsorption is removed from the adsorbent heat exchanger inflow of cooling water

8G by the cooling water supplied via the piping L19 and L25.
[0026]If adsorption of the portion 22B is completed, as drawing 2 shows, opening and closing valve V9-2 will be opened wide, and a steam will be made to flow into the portion 22C via the piping 26-2 for gaseous phase heat carriers, as the arrow G5 shows. In this case, in order to heat the 2nd adsorbent heat exchanger 24B, warm water is supplied via the piping L23 and L26 from the hot water inlet 9G. On the other hand, in order to cool the 3rd adsorbent heat exchanger 24C, cooling water is supplied via the piping L11 and L13 from the adsorbent heat exchanger inflow of cooling water 8G.

[0027]If adsorption of the portion 22C is completed, it will desorb by heating the 3rd adsorbent heat exchanger 24C with the warm water supplied via the piping L17, L14, and L13 from the hot water inlet 9G, as again shown in drawing 3. As a result, as the arrow G6 of drawing 3 shows, a steam is sent to the condenser 4 via the piping 30-2. And it is sent to the evaporator 3 via the piping 32 in the state of the liquid phase (numerals HL).
[0028]In the example of a graphic display, even if it sets the temperature of the chilled water which can obtain 31 ** of circulating water temperature as 7 ** (it operates by a rated condition), the temperature of warm water operates enough at 56 **. That is, desorption in each heat-of-adsorption exchanger 24A-24D is performed at about 56 **. This provides two portions (22A, 22D, or 22B and 22C) in each system, two heat-of-adsorption exchangers (24A and 24D.) with an operation adsorption concentration range which opens between each portion for free passage by the piping 26-1 for gaseous phase heat carriers, or 26-2, and is different in a heat carrier Or it is because the fall of a temperature required for a heat carrier to desorb by making it move to 24B and 24C in different maximum vapor tension one by one was aimed at.
[0029]It writes in addition that the example of a graphic display is not what is illustration to the last and means limitation of the technical scope of this invention.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The block diagram showing the composition of one example of this invention.
[Drawing 2]The block diagram showing an operation of the example shown by drawing 1.
[Drawing 3]The block diagram showing another state with drawing 2.
[Drawing 4]The explanatory view showing a conventional example.
[Description of Notations]
1, 20 ... Adsorption freezer
2 ... Body part
3 ... Evaporator
4 ... Condenser
A, B, 22A, 22B, 22C, 22D ... Field inside a body part (portion)
5A, 5B, 24A, 24B, 24C, 24D ... Adsorbent heat exchanger
L1-L4, L11-L25, 26-1, 26-2, 28-1, 28-2, 30-1, 30-2, 32 ... Piping
HG1, HG2, G1-G6 ... Steam
HL ... Water of condensation
6A, 6B, 7A, 7B ... Partition lid
8G ... Adsorbent heat exchanger inflow of cooling water
8B ... Adsorbent heat exchanger outflow of cooling water
V1-V5, V20-V27, V ... Valve
9G ... Hot water inlet
9B ... Hot water outlet

[Translation done.]

* NOTICES *

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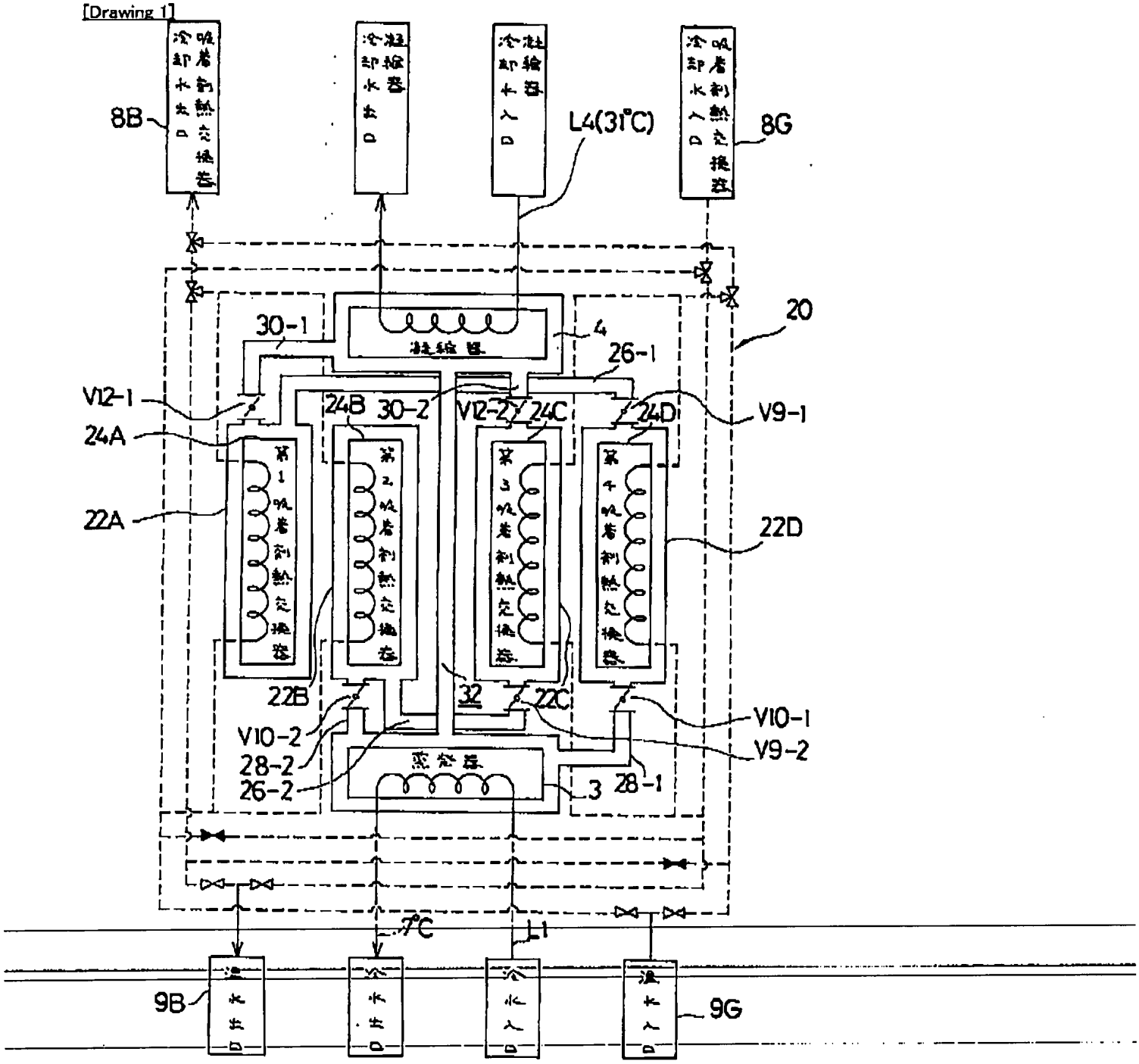
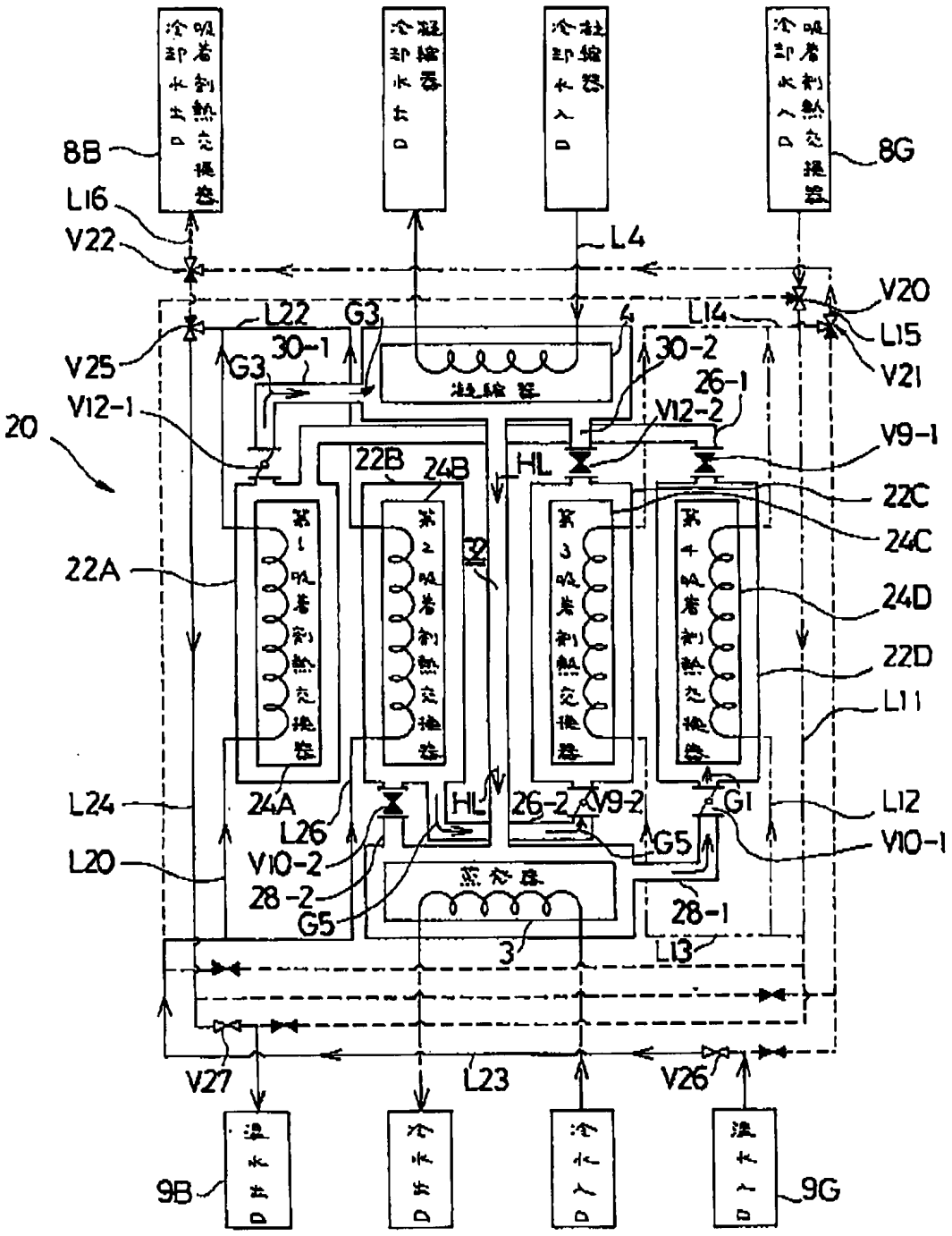
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

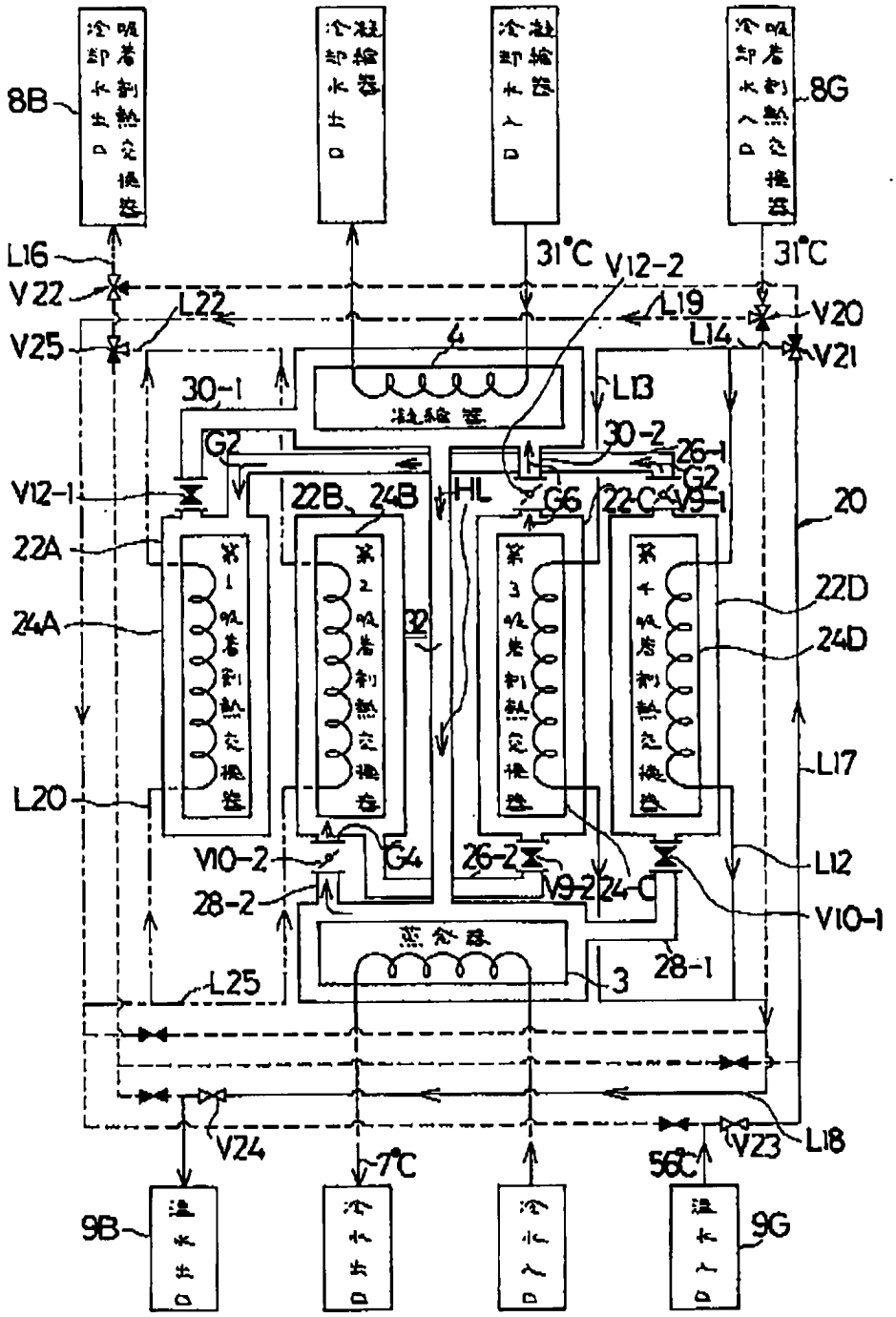
[Drawing 1]



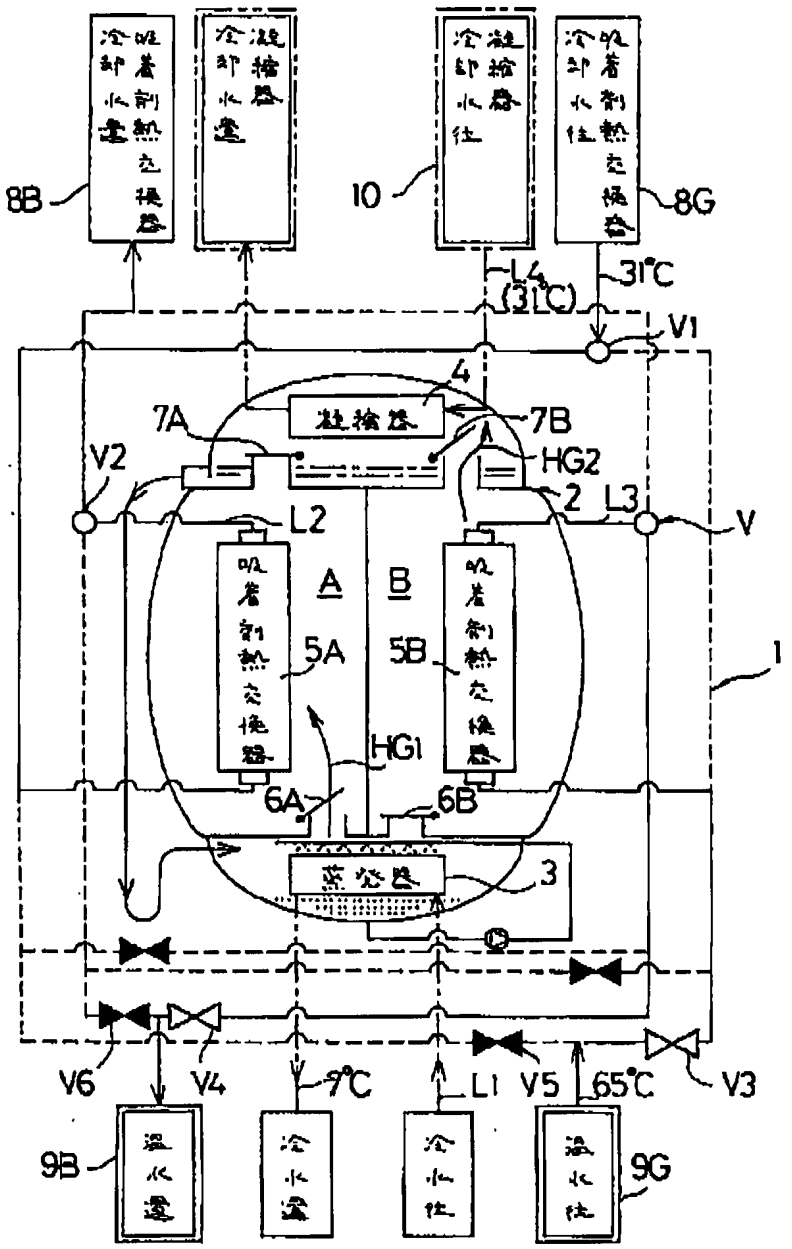
[Drawing 2]


8B
8G
L16
V22
L4
V20
L22
G3
L14
L15
V25
30-1
30-2
V21
G3
26-1
V12-1
V12-2
20
V9-1
22B
24B
HL
22C
24C
22A
32
24D
22D
L11
L24
24A
L26
HL
26-2
V9-2
G1
L12
V10-1
L20
V10-2
G5
28-2
28-1
G5
3
L3
V27
L23
V26
9B
9G

[Drawing 3]


8B
8G
L16
V22
V25
L22
31°C
V12-2
L19
31°C
V20
L14
V21
4
30-1
L13
30-2
26-1
G2
V12-1
22B
24B
HL
G6
22C
V9-1
20
22A
24A
32
22D
24D
L17
L20
V10-2
G4
26-2
V9-2
24-C
L12
V10-1
28-2
3
28-1
L25
V24
7°C
56°C
V23
L18
9B
9G

[Drawing 4]



[Translation done.]

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Ｆ２５Ｂ　17/08		Ｂ　7409－3Ｌ		

審査請求　未請求　請求項の数１(全　８　頁)

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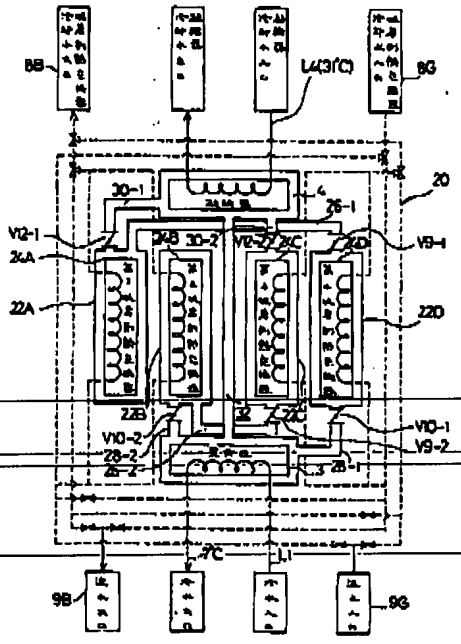
(54)【発明の名称】　吸着冷凍機

(57)【要約】

【目的】　定格条件（冷水温度が７℃、冷却水温度が３１℃）あっても、６０℃以下の低質排熱を駆動熱源として利用する事が出来る様な吸着冷凍機の提供。

【構成】　吸着剤熱交換器（２４Ａ－２４Ｄ）を介装した複数の系統を含む吸着冷凍機（２０）において、前記複数の系統の各々は吸着剤熱交換器を備えた独立した領域（２２Ａ－２２Ｄ）を複数含んで構成され、該複数の領域は気相熱媒用の配管（２６－１、２６－２）で連通している。



1

【特許請求の範囲】

【請求項１】 蒸発器と、蒸発器に液相熱媒を供給する配管系と、蒸発器の熱交換により冷却される冷水の配管系と、凝縮器と、凝縮器に冷却水を供給する配管系と、吸着剤熱交換器を介装した複数の系統および吸着剤熱交換器に温水または冷却水を供給する配管系、とを含む吸着冷凍機において、前記複数の系統の各々は吸着剤熱交換器を備えた独立した領域を複数含んで構成され、該複数の領域は気相熱媒用の配管で連通している事を特徴とする吸着冷凍機。

【発明の詳細な説明】

【０００１】

【産業状の利用分野】本発明は、蒸発器と、蒸発器に液相熱媒を供給する配管系と、蒸発器の熱交換により冷却される冷水の配管系と、凝縮器と、凝縮器に冷却水を供給する配管系と、吸着剤の熱交換器を介装した複数の系統および吸着剤熱交換器に温水または冷却水を供給する配管系、とを含む吸着冷凍機に関する。

【０００２】

【従来の技術】この様な吸着冷凍機の従来例が図４で示されている。この吸着冷凍機は熱媒として水を利用し、吸着剤としてシリカゲル或いはゼオライトを用いている。全体を符号１で示す吸着冷凍機の本体部２には、蒸発器３と、凝縮器４とが包含されている。本体部２の内部は符号Ａ、Ｂで示す２つの領域に分離されており、その領域にはそれぞれ吸着剤熱交換器５Ａ、５Ｂが設けられている。

【０００３】蒸発器３に噴霧された熱媒（水）は、蒸発して気化熱を奪い、配管系Ｌ１を循環する冷水を冷却する。そして図４の状態では、符号ＨＧ１で示す蒸発した熱媒（水蒸気）は開放状態の仕切蓋６Ａを介して領域Ａに流入し、吸着剤熱交換器５Ａに充填された吸着剤（シリカゲル或いはゼオライト）により吸着される。ここで吸着剤は水分を吸着すると発熱するので、配管系Ｌ２を介して供給される冷却水により冷却される。配管系Ｌ２に冷却水を供給するためには、冷却水供給源８Ｇからの冷却水回収手段８Ｂに亘る配管系に介装された切り換え弁Ｖ１、Ｖ２を、図４において実線で示す系統に切り換えればよい。なお、領域Ａ上方の仕切蓋７Ａは閉鎖状態であるため、水蒸気は上方に漏出する事無く、熱交換器５Ａ中の吸着剤により十分に吸着される。

【０００４】一方、図４の領域Ｂでは吸着剤熱交換器５Ｂによる吸着が完了しており、そのため下方の仕切蓋６Ｂを閉鎖状態として水蒸気が流入しないようになっている。この状態では、熱交換器５Ｂの吸着剤は飽和状態近くまで水蒸気を吸着しており、配管系Ｌ３を介して温水を供給すると、吸着された水分が吸着剤から分離して（脱着）、符号ＨＧ２で示す様に、開放状態にある上方の仕切蓋７Ｂから凝縮器４側へ流出する。そして、吸着剤から脱着した水分（水蒸気）ＨＧ２は、配管系Ｌ４を

2

介して凝縮器４に供給される冷却水との熱交換により、凝縮熱を奪われて液相、すなわち水、に変化する。この水は図示しない配管系を経由して、蒸発器３に噴霧される。なお、吸着剤熱交換器５Ｂに温水を供給するためには、温水源９Ｇと温水回収手段９Ｂとの間の配管系に介装された開閉弁の内、図中黒く示された開閉弁Ｖ３、Ｖ４を開放し、白で示された開閉弁Ｖ５、Ｖ６を閉鎖するとともに切り替え弁Ｖを図中において実線で示す系統に切り換えれば良い。

【０００５】領域Ａにおける吸着及び領域Ｂにおける脱着が完了すると、開放状態の仕切蓋６Ａ、７Ｂを閉鎖し、閉鎖状態の仕切蓋６Ｂ、７Ａを開放する。そして、切り換え弁Ｖ１、Ｖを図４で点線で示す系統側に切り換える事により吸着剤熱交換器５Ｂ側に冷却水を供給せしめる。更に、開閉弁Ｖ３、Ｖ４を閉鎖して、開閉弁Ｖ５、Ｖ６を開放するとともに切り替え弁Ｖ２を、図中の点線で示す系統側に切り換える事により、吸着剤熱交換器５Ａ側に脱着用の温水を供給せしめる。

【０００６】図４で示す吸着冷凍機１を一般空調用に用いる場合、吸着剤熱交換器への冷却水源及び凝縮器４の冷却水源１０からの冷却水の入口温度（吸着冷凍機１へ流入する際の温度）は定格温度３１℃が、蒸発器３において冷却された冷水の出口温度（吸着冷凍機１から流出する際の温度）は定格温度７℃が望まれている。そして従来は、温水源９Ｇからの温水の入口温度は６５℃程度が必要とされていた。換言すれば、図４で示す吸着冷凍機１では、一般空調用として望まれる定格条件で運転するためには、駆動熱源の温度として６５℃程度が必要とされていた。

【０００７】

【発明が解決しようとする課題】６０℃以下の比較的低い温度の排熱は俗に「低質排熱」と呼ばれ、従来は単に廃棄（排熱）するのみであった。ここで、省エネルギーが大きな課題となっている近年では、この様な低質排熱であっても有効利用したいという要請が非常に強い。

【０００８】しかし、上述した様に従来の吸着冷凍機では、定格条件（冷却水温度が３１℃、得られた冷水の温度が７℃）で運転するためには、駆動熱源の温度として６５℃程度が要求されており、６０℃以下の低質排熱を駆動熱源として利用する事が出来ない。

【０００９】本発明は上述した従来技術の問題点に鑑みて提案されたもので、冷却水温度が３１℃、得られた冷水の温度が７℃（定格条件による運転）であっても、６０℃以下の低質排熱を駆動熱源として利用する事が出来る様な吸着冷凍機の提供を目的としている。

【００１０】

【課題を解決するための手段】本発明の吸着冷凍機によれば、蒸発器と、蒸発器に液相熱媒を供給する配管系と、蒸発器の熱交換により冷却される冷水の配管系と、凝縮器と、凝縮器に冷却水を供給する配管系と、吸着剤

熱交換器を介装した複数の系統および吸着剤熱交換器に温水または冷却水を供給する配管系、とを含む吸着冷凍機において、前記複数の系統の各々は吸着剤熱交換器を備えた独立した領域を複数含んで構成され、該複数の領域は気相熱媒用の配管で連通している。

【００１１】本発明の実施に際して、吸着剤熱交換器を介装した系統は例えば２系統設けるのが好ましいが、３系統以上設けても良い。そして、各系統には吸着剤熱交換器を設けた独立した領域を２つ以上含んで構成されるのが好ましい。

【００１２】

【作用】上述した様な構成を具備する本発明の吸着冷凍機によれば、各系統は吸着剤熱交換気器を設けた複数、例えば２つ、の領域を含んで構成されており、その領域を気相熱媒用の配管で連通しているので、熱媒（水或いは水蒸気）の濃度を変更して飽和蒸気圧を調節・制御する事が可能となる。蒸発器を出た気相熱媒（水蒸気）は冷却水の流れる吸着剤熱交換器を設けた第１の領域へ流入し、吸着される。第１の領域における吸着が完了すると、第２の領域へ連通する気相熱媒用の配管に介装された開閉弁が開放する。ここで、第１の領域の熱交換器に温水を流し、第２の領域の熱交換器に冷却水を流すと、温度差或いは圧力差により第１の領域中で吸着された熱媒が脱着されて、第２の領域に流入しそこの熱交換器の吸着剤によって吸着される。そして、第２の領域の吸着剤熱交換器に温水を供給すると、熱媒が脱着されて気相熱媒として凝縮器側へ流入する。そして、凝縮器の冷却水と熱交換を行い、液相熱媒となり、凝縮液配管を通り蒸発器に再び噴霧されて蒸発するのである。

【００１３】従来のように単一の領域内にて吸着・脱着を繰り返す場合には飽和蒸気圧の調節は不可能である。したがって、冷却水温度が３１℃、得られる冷水の温度が７℃であれば（定格条件による運転）、温水は６５℃程度の温度が必要であった。これに対して本発明では、気相熱媒用の配管を介して熱媒が異なる領域間を移動する際に飽和蒸気圧が調節されて、６０℃以下（例えば５６℃）の温水が吸着剤熱交換器に供給されても熱媒（水）が蒸発して脱着される。すなわち、気相熱媒用の配管を介して熱媒を異なる領域間で順次移動させ、等吸着量温度線図上で吸着剤熱交換器の作動吸着濃度領域を調節することにより熱媒が脱着するのに必要な吸着剤温度が低下する方向にスライドさせるのである。この場合、吸着冷凍機のサイクル線図において３水準以上の飽和蒸気圧が存在する。

【0014】

【実施例】以下、図１－３を参照して、本発明の１実施例について説明する。なお、図４で示すのと同一の部材には、同一の符号を付してある。

【００１５】図１において符号２０で示す本発明の吸着冷凍機は、熱媒として水を使用している。すなわち、液

相熱媒としては水（凝縮水）、気相熱媒としては水蒸気が用いられている。

【００１６】吸着冷凍機２０は、添え字Ａ、Ｄを付して示す系統と、添え字Ｂ、Ｃを付して示す系統の２系統を含んで構成されている。そして、独立した領域或いは部分２２Ａ、２２Ｂ、２２Ｃ、２２Ｄと、その内部に設けられた第１吸着剤熱交換器２４Ａ、第２吸着剤熱交換器２４Ｂ、第３吸着剤熱交換器２４Ｃ、第４吸着剤熱交換器２４Ｄを含んでいる。

【００１７】部分２２Ａと２２Ｄは、熱媒用配管２６－１により連通しており、一方、部分２２Ｂと２２Ｃは熱媒用配管２６－２により連通している。そして、部分２２Ａと２２Ｄを含む系統は、開閉弁Ｖ１０－１を介装した配管２８－１を介して蒸発器３と連通し、部分２２Ｂと２２Ｃとを含む系統は開閉弁Ｖ１０－２を介装した配管２８－２を介して蒸発器３と連通している。さらに、部分２２Ａ、２２Ｄを含む系統及び部分２２Ｂ、２２Ｃを含む系統は、それぞれ、開閉弁Ｖ１２－１を介装した配管３０－１、開閉弁Ｖ１２－２を改装した配管３０－２を介して、凝縮器４に連通している。なお、凝縮器４と蒸発器３は、配管３２（液相熱媒用配管）を介して連通している。

【００１８】第１吸着剤熱交換器２４Ａ、第２吸着剤熱交換器２４Ｂ、第３吸着剤熱交換器２４Ｃ、第４吸着剤熱交換器２４Ｄと、吸着剤熱交換器冷却水入口８Ｇ、吸着剤熱交換器冷却水出口８Ｂ、温水入口９Ｇ、温水出口９Ｂは、開閉弁及び三方弁が介装された図１では点線で示す様な配管系により連通しているが、その詳細については図２、３を参照して後述する。

【００１９】図２において、蒸発器３で発生した水蒸気は、矢印Ｇ－１で示す様に、弁Ｖ１０－１が開放している配管２８－１を介して部分２２Ｄに流入し、第４吸着剤熱交換器２４Ｄで吸着される。図２の状態では、吸着剤熱交換器入口８Ｇのすぐ下流に配置された三方弁Ｖ２０は、該入口８Ｇからの冷却水を配管Ｌ１１に流入させる。配管Ｌ１１は配管Ｌ１２、Ｌ１３に分岐して、配管Ｌ１２を流れる冷却水は第４吸着剤熱交換器２４Ｄが水分を吸着する際に発熱するのを冷却する。なお、熱交換器２４Ｄを冷却した後、配管Ｌ１２内を流れる冷却水は配管Ｌ１４に合流して、三方弁Ｖ２１を介して配管Ｌ１５に流入せられる。そして、三方弁Ｖ２２、配管Ｌ１６を介して、吸着剤熱交換器冷却水出口８Ｂに送られる。

【００２０】ここで、気相熱媒用配管２６－１に介装された開閉弁Ｖ９－１は閉鎖状態であるため、部分２２Ｄに流入した水蒸気は当該部分２２Ｄに留まり、吸着剤により効率良く吸着される。

【００２１】部分２２Ｄにおける吸着が終了すると、図３で示すように、開閉弁Ｖ－１－０－１を閉鎖し、弁Ｖ－９－１を開放する。同時に、温水入口９Ｇ近傍の開閉弁Ｖ２３を開放し、温水を配管Ｌ１７内に流入する。更に、三

方弁Ｖ２１を切り換えて温水を配管Ｌ１４に流し、Ｌ１４から分岐した配管Ｌ１２を流れる温水が第４吸着剤熱交換器２４Ｄを加熱する。温水により吸着剤が加熱されるので、吸着された水分は脱着する。ここで、部分２２Ａは部分２２Ｄよりも低温・低圧であるため、第４吸着剤熱交換器２４Ｄを脱着した水分は、矢印Ｇ２で示す様に、気相熱媒用配管２６－１を介して部分２２Ａに流入する。なお、熱交換器２４Ｄに供給された温水は、配管Ｌ１８及び開閉弁Ｖ２４を介して温水出口９Ｂに戻される。

【００２２】部分２２Ａに流入した水分は、第１吸着剤熱交換器２４Ａにより吸着される。吸着に際して発生した熱は、吸着剤熱交換器冷却水入口８Ｇから、弁Ｖ２０、配管Ｌ１９、Ｌ２０を介して供給される冷却水により除去される。なお、この冷却水は、配管Ｌ２２、弁Ｖ２５、Ｖ２２、配管Ｌ１６を介して、吸収剤熱交換器冷却水出口８Ｂへ送出される。

【００２３】部分２２Ａにおける吸着が完了すると、再び図２で示す状態となる。すなわち、開閉弁Ｖ２６、Ｖ２７が開放されるため、温水は温水出口９Ｇより、開閉弁Ｖ２６、配管Ｌ２３、Ｌ２０を介して第１吸着剤熱交換器２４Ａを加熱する。なお、加熱後、温水は配管Ｌ２２、弁Ｖ２５、配管Ｌ２４、弁Ｖ２７を介して温水出口９Ｂに戻される。

【００２４】第１吸着剤熱交換器２４Ａが加熱されて吸着された水分が脱着すると共に、開閉弁Ｖ１２－１が開放するので、脱着された水分（水蒸気）は矢印Ｇ３で示す様に、配管３０－１を介して凝縮器４に到達する。そして凝縮器４で凝縮して液相に変化する。そして、凝縮水は矢印ＨＬで示す様に、配管３２を介して蒸発器３に噴霧される。

【００２５】以上は部分２２Ａ、２２Ｄを含む系統について説明したが、部分２２Ｂ、２２Ｃを含む系統についても同様である。この系統による熱媒の循環経路を説明すると、先ず、図３で示す様に、蒸発器３で蒸発した水蒸気は、矢印Ｇ４で示す様に、配管２８－２、開閉弁Ｖ１０－２を介して部分２２Ｂに流入する。そして、第２吸着剤熱交換器２４Ｂで吸着される。吸着による発熱は、吸着剤熱交換器冷却水入口８Ｇから配管Ｌ１９、Ｌ２５を介して供給される冷却水により除去される。

【００２６】部分２２Ｂの吸着が完了したならば、図２で示す様に開閉弁Ｖ９－２を開放して、矢印Ｇ５で示す様に、水蒸気を気相熱媒用配管２６－２を介して部分２２Ｃに流入させる。この際に、第２吸着剤熱交換器２４Ｂを加熱するため、温水入口９Ｇより、配管Ｌ２３、Ｌ２６を介して温水を供給する。一方、第３吸着剤熱交換器２４Ｃを冷却するため、吸着剤熱交換器冷却水入口８Ｇから、配管Ｌ１１、Ｌ１８を介して冷却水が供給される。

【００２７】部分２２Ｃの吸着が完了すると、再び図３

に示すように温水入口９Ｇから配管Ｌ１７、Ｌ１４、Ｌ１３を介して供給される温水により第３吸着剤熱交換器２４Ｃを加熱し、脱着を行う。その結果、図３の矢印Ｇ６で示す様に水蒸気が配管３０－２を介して凝縮器４に送られる。そして、液相（符号ＨＬ）の状態で配管３２を介して蒸発器３へ送られるのである。

【００２８】図示の実施例において、冷却水温度を３１℃、得られる冷水の温度を７℃に設定（定格条件で運転）しても、温水の温度は５６℃で十分作動する。すなわち、各吸着熱交換器２４Ａ－２４Ｄにおける脱着は５６℃程度で行われる。これは、各系統に２つの部分（２２Ａと２２Ｄ、或いは２２Ｂと２２Ｃ）を設け、各部分間を気相熱媒用配管２６－１或は２６－２で連通し、熱媒を異なる作動吸着濃度領域をもつ２つの吸着熱交換器（２４Ａと２４Ｄ、或いは２４Ｂと２４Ｃ）に順次異なる飽和蒸気圧において移動させることにより熱媒が脱着するのに必要な温度の低下をはかったためである。

【００２９】なお、図示の実施例はあくまでも例示であり、本発明の技術的範囲の限定を意図するものではない事を付記する。

【００３０】

【発明の効果】本発明の作用効果を以下に列挙する。

【００３１】（１）　６０℃以下の低質排熱（低温排熱）が吸着冷凍機の熱源として有効利用される。

【００３２】（２）　省エネルギーの要請に応える事が出来る。

【図面の簡単な説明】

【図１】本発明の１実施例の構成を示すブロック図。

【図２】図１で示す実施例の作用を示すブロック図。

【図３】図２とは別の状態を示すブロック図。

【図４】従来例を示す説明図。

【符号の説明】

１、２０・・・吸着冷凍機

２・・・本体部

３・・・蒸発器

４・・・凝縮器

Ａ、Ｂ、２２Ａ、２２Ｂ、２２Ｃ、２２Ｄ・・・本体部内部の領域（部分）

５Ａ、５Ｂ、２４Ａ、２４Ｂ、２４Ｃ、２４Ｄ・・・吸着剤熱交換器

Ｌ１－Ｌ４、Ｌ１１－Ｌ２５、２６－１、２６－２、２８－１、２８－２、３０－１、３０－２、３２・・・配管

ＨＧ１、ＨＧ２、Ｇ１－Ｇ６・・・水蒸気

ＨＬ・・・凝縮水

６Ａ、６Ｂ、７Ａ、７Ｂ・・・仕切蓋

８Ｇ・・・吸着剤熱交換器冷却水入口

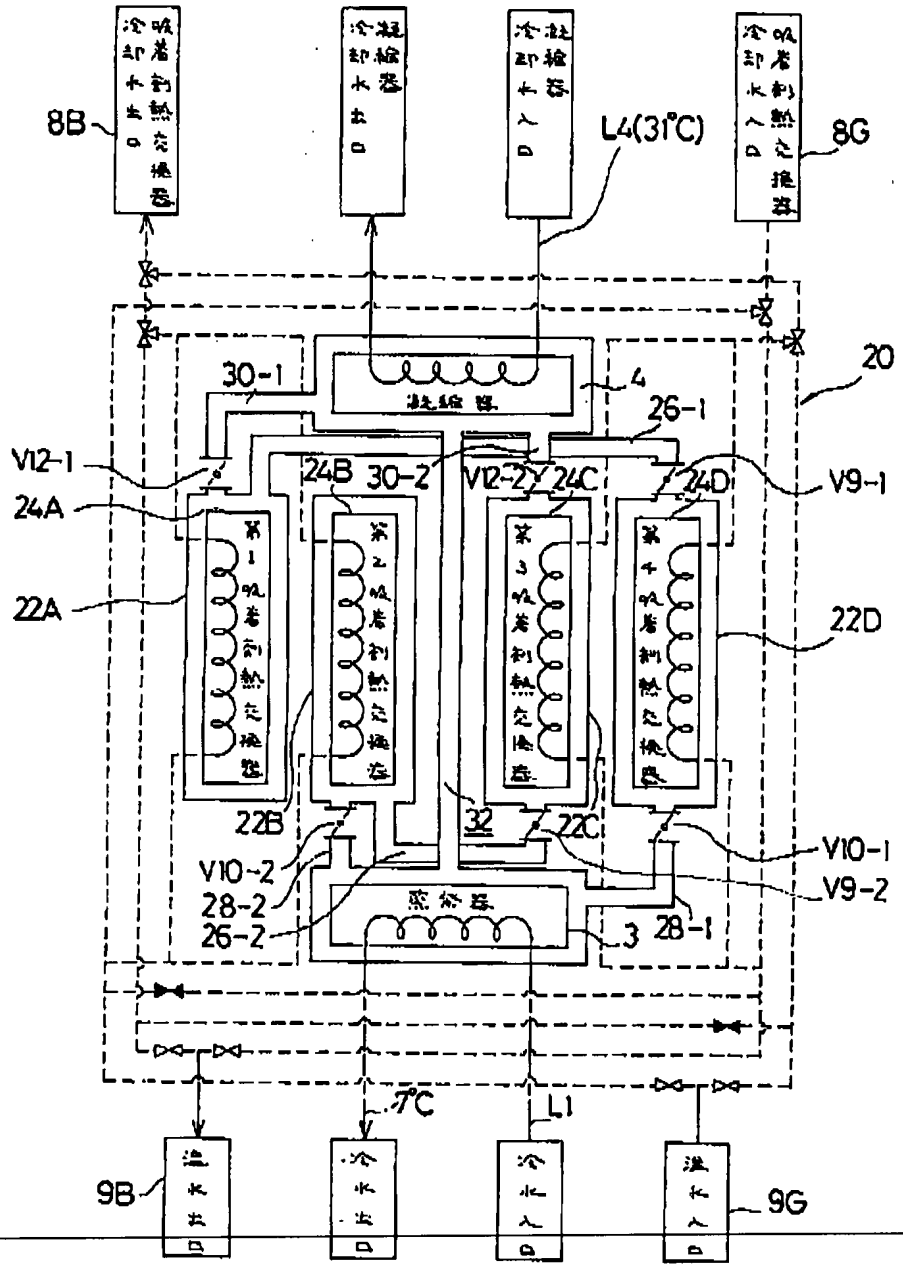
８Ｂ・・・吸着剤熱交換器冷却水出口

Ｖ１－Ｖ５、Ｖ２０－Ｖ２７、Ｖ・・・弁

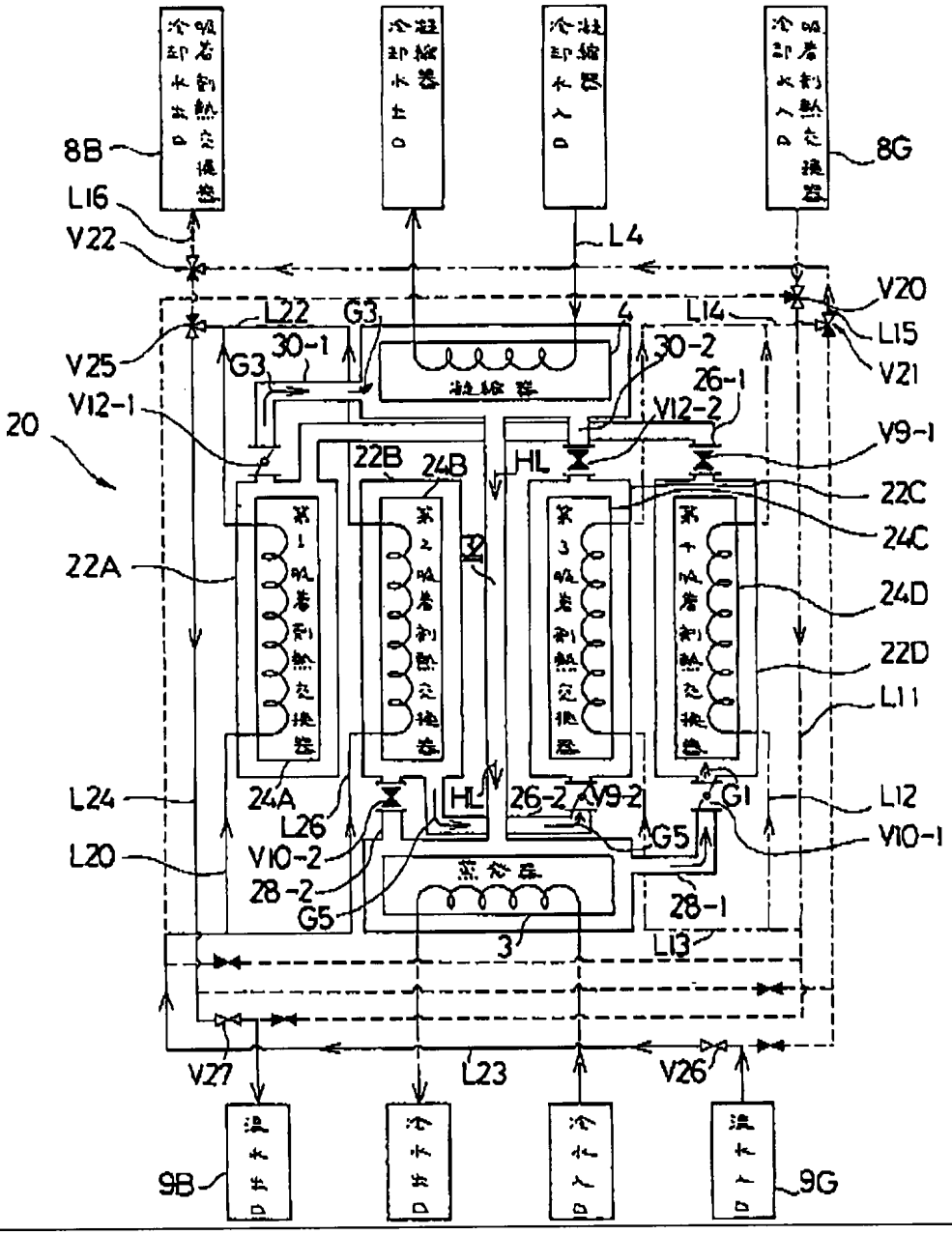
９Ｇ・・・温水入口

9B・・・温水出口

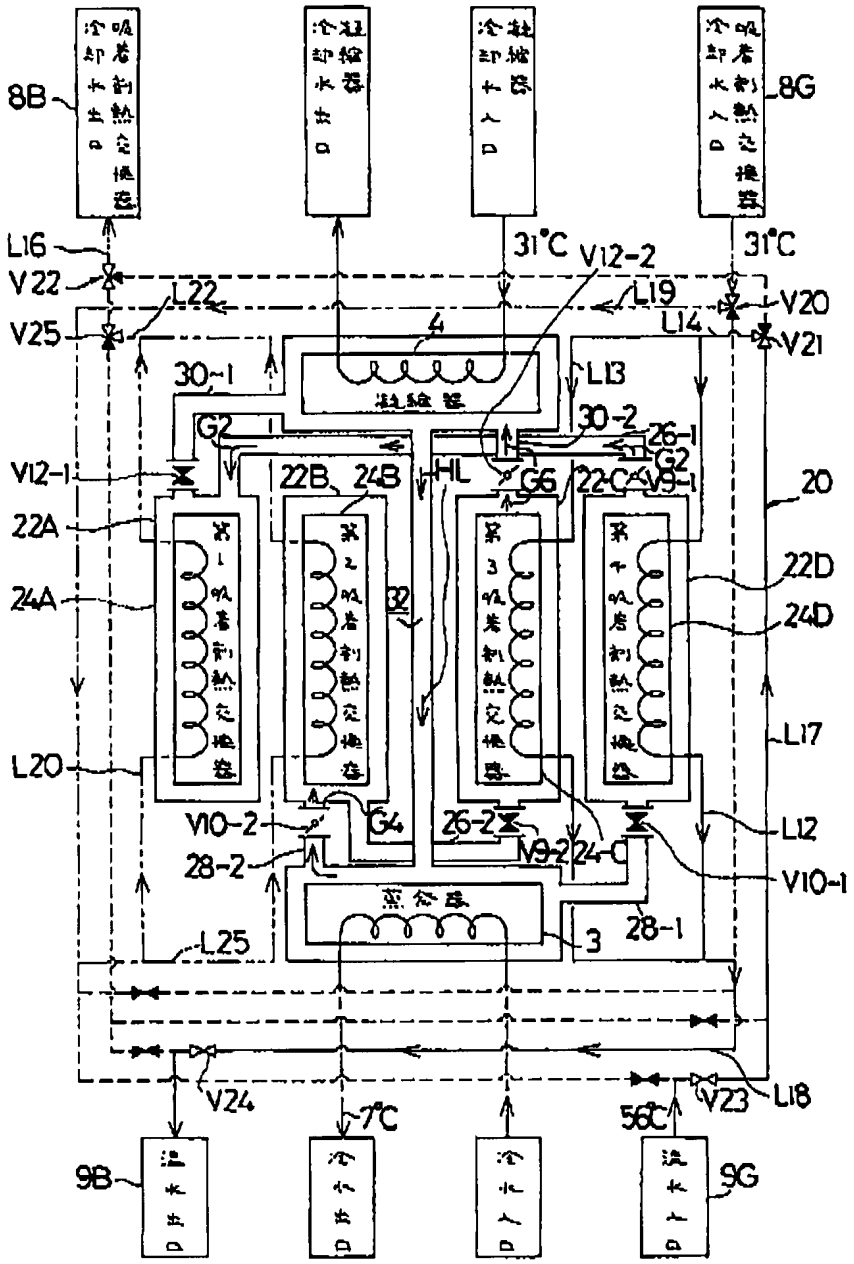
【図1】


8B
L4(31℃)
8G
20
30-1
4
26-1
V12-1
24B
30-2
V12-2
24C
24D
V9-1
24A
22A
22D
22B
32
22C
V10-1
V10-2
V9-2
28-2
26-2
3
28-1
7℃
L1
9B
9G

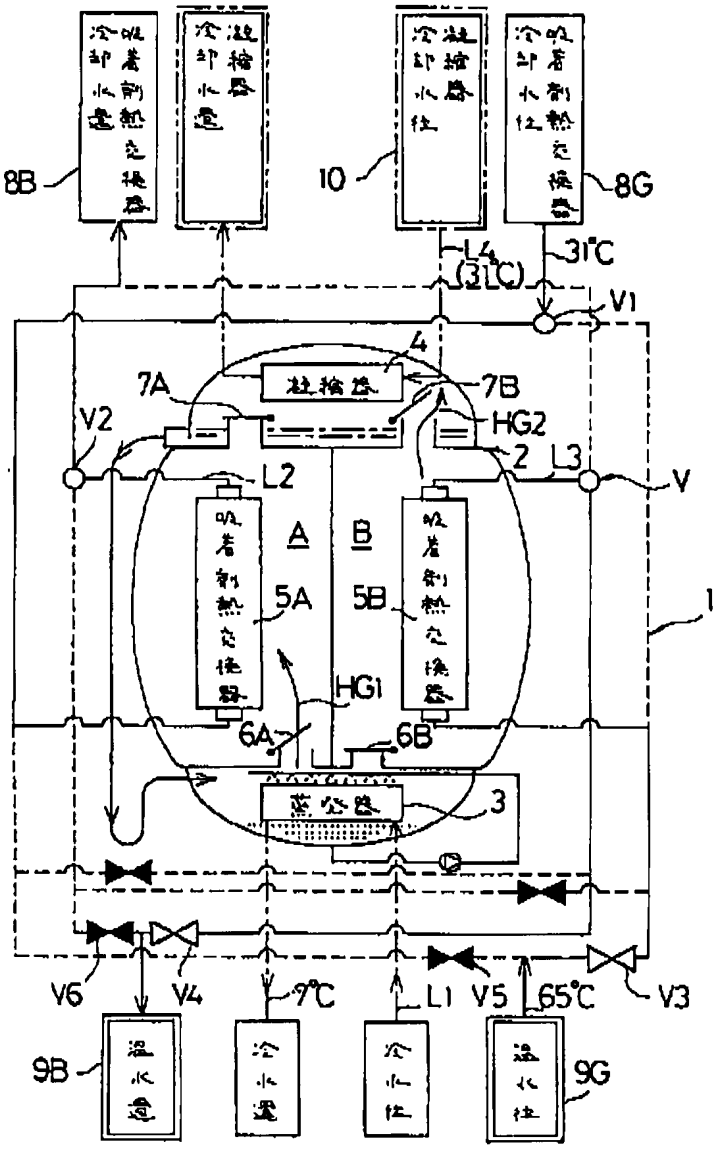
【図2】


8B
8G
L16
V22
L4
V20
L22
G3
4
L14
L15
V25
30-1
30-2
V21
G3
26-1
V12-1
V12-2
20
V9-1
22B
24B
HL
22C
24C
22A
3
24D
22D
L11
L24
24A
HL
26-2
V9-2
G1
L12
L26
G5
V10-1
L20
V10-2
28-2
G5
28-1
3
L13
V27
L23
V26
9B
9G

【図３】


8B
8G
L16
V22
V25
L22
31°C
V12-2
L19
V20
L14
V21
31°C
4
30-1
L13
30-2
26-1
G2
V12-1
22B
24B
HL
G6
22C
V9-1
20
22A
24A
32
22D
24D
L20
L17
V10-2
G4
26-2
V9-2
24C
L12
V10-1
28-2
3
28-1
L25
V24
7°C
56°C
V23
L18
9B
9G

【図4】


8B
10
8G
L4
(31℃)
31℃
V1
4
7A
7B
HG2
V2
2
L3
V
L2
A
B
5A
5B
1
HG1
6A
6B
3
V6
V4
7℃
L1
V5
65℃
V3
9B
9G